AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims

1.(currently amended) A method of determining a permittivity of a dielectric layer of a semiconductor wafer comprising:

(a) providing a means for contacting a topside of a semiconductor wafer, the contact means including at least a partially spherical surface formed from a conductive material;

(b) determining a thickness of a dielectric layer on the semiconductor wafer having semiconducting material underlying the dielectric layer;

(c) causing ~~the topside of the semiconductor wafer to support~~ the at least partially spherical surface of the contact means to contact the topside of the semiconductor wafer ~~in spaced relation to the semiconducting material~~ thereby defining a capacitor;

(d) applying an electrical stimulus to the contact means and the semiconducting material when the capacitor is defined;

(e) determining a capacitance of the capacitor from the response thereof to the applied electrical stimulus; and

(f) determining a permittivity of the dielectric layer as a function of the capacitance determined in step (e), ~~and~~ the thickness of the dielectric layer determined in step (b) and the thickness of a gap between the surface of the contact means and the topside of the semiconductor wafer adjacent where the surface of the contact means contacts the topside of the semiconductor wafer.

2.(original) The method of claim 1, wherein the topside of the semiconductor wafer comprises at least one of:

a surface of the dielectric layer opposite the semiconducting material; and

a surface of organic(s) and/or water overlaying the surface of the dielectric layer opposite the semiconducting material.

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3.(original) The method of claim 1, further including desorbing at least one of water and organic(s) from a surface of the dielectric layer.

4.(original) The method of claim 1, wherein the at least partially spherical surface is formed from a conductive material that either does not form an oxide layer or forms a conductive oxide on the surface thereof.

5.(currently amended) The method of claim 1, wherein the capacitance determined in step (e) includes a sum of:

a capacitance where the contact means contacts the topside of the semiconductor wafer ~~supports the contact means in spaced relation to the semiconducting material~~; and

a capacitance of ~~a~~ the gap between the surface of the contact means and the topside of the semiconductor wafer adjacent where the surface of the contact means contacts the topside of the semiconductor wafer ~~supports the contact means in spaced relation to the semiconducting material~~.

6.(currently amended) The method of claim 2, wherein the permittivity of the dielectric layer (ε_{ox}) is determined utilizing the formula:

$$C = \varepsilon_0 A[(T_p/\varepsilon_p) + (T_{ox}/\varepsilon_{ox}) + (T_{org}/\varepsilon_{org})]^{-1} + 2\pi\varepsilon_0\varepsilon_{H_2O}R\ln\left[\frac{(T_p/\varepsilon_p) + (T_{ox}/\varepsilon_{ox}) + (T_{org}/\varepsilon_{org}) + (T_{H_2O}/\varepsilon_{H_2O})}{(T_p/\varepsilon_p) + (T_{ox}/\varepsilon_{ox}) + (T_{org}/\varepsilon_{org})}\right] + 2\pi\varepsilon_0 R\ln\left[\frac{(T_p/\varepsilon_p) + (T_{ox}/\varepsilon_{ox}) + (T_{org}/\varepsilon_{org}) + (T_{H_2O}/\varepsilon_{H_2O}) + (T_{gap})}{(T_p/\varepsilon_p) + (T_{ox}/\varepsilon_{ox}) + (T_{org}/\varepsilon_{org}) + (T_{H_2O}/\varepsilon_{H_2O})}\right]$$

where C = the capacitance determined in step (e);

ε_0 = permittivity of free space;

A = contact area of the contact means in contact with the topside of the semiconductor wafer;

R = radius of curvature of the contact means;

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ln= natural log;

T_p = thickness of an oxide layer (if any) on the surface of the contact means;

ε_p = permittivity of the oxide layer;

T_{ox} = thickness of the dielectric layer;

ε_{ox} = permittivity of the dielectric layer;

T_{org} = thickness of the organic(s) (if any) overlaying the dielectric layer;

ε_{org} = permittivity of the organic(s);

T_{H_2O} = thickness of the water (if any) overlaying the dielectric layer;

ε_{H_2O} = permittivity of the water; and

T_{gap} = thickness of ~~a~~ the gap between the surface of the contact means and the topside of the semiconductor wafer adjacent where the surface of the contact means contacts the topside of the semiconductor wafer ~~supports the surface of the contact means in spaced relation to the semiconducting material~~.

7. (currently amended) A system for determining a permittivity of a dielectric layer of a semiconductor wafer comprising:

means for contacting a topside of a semiconductor wafer, the contact means including at least a partially spherical surface formed from a conductive material;

means for determining a thickness of a dielectric layer on the semiconductor wafer having semiconducting material underlying the dielectric layer;

means for moving the topside of the semiconductor wafer and the at least partially spherical surface of the contact means into contact thereby defining with the dielectric layer a capacitor;

means for applying an electrical stimulus to the contact means and the semiconducting material when the capacitor is defined; and

means for determining a capacitance of the capacitor from the response of the capacitor to the applied electrical stimulus ~~a capacitance of the capacitor~~; and

means for determining ~~therefrom~~ a permittivity of the dielectric layer as a function of the capacitance, ~~and~~ the thickness of the dielectric layer and a thickness of a gap between the surface

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of the contact means and the topside of the semiconductor wafer adjacent where the surface of the contact means contacts the topside of the semiconductor wafer.

8. (original) The system of claim 7, wherein the topside of the semiconductor wafer comprises at least one of:

a surface of the dielectric layer opposite the semiconducting material; and

a surface of organic(s) and/or water overlaying the surface of the dielectric layer opposite the semiconducting material.

9. (original) The system of claim 7, further including means for desorbing at least one of water and organic(s) from a surface of the dielectric layer.

10. (original) The apparatus of claim 7, wherein the at least partially spherical surface is formed from a conductive material that either does not form an oxide layer or forms a conductive oxide on the surface thereof.

11. (currently amended) The system of claim 7, wherein the determined capacitance includes a sum of:

a capacitance where the contact means contacts the topside of the semiconductor wafer ~~supports the contact means in spaced relation to the semiconducting material~~; and

a capacitance of ~~a~~ the gap between the surface of the contact means and the topside of the semiconductor wafer adjacent where the surface of the contact means contacts the topside of the semiconductor wafer ~~supports the contact means in spaced relation to the semiconducting material~~.

12. (currently amended) The system of claim 11, wherein the means for determining the permittivity of the dielectric layer utilizes the formula:

$$C = \varepsilon_0 A[(T_p/\varepsilon_p) + (T_{ox}/\varepsilon_{ox}) + (T_{org}/\varepsilon_{org})]^{-1} +$$

$$2\pi\varepsilon_0\varepsilon_{H_2O}R\ln\left[\frac{(T_p/\varepsilon_p)+(T_{ox}/\varepsilon_{ox})+(T_{org}/\varepsilon_{org})+(T_{H_2O}/\varepsilon_{H_2O})}{(T_p/\varepsilon_p)+(T_{ox}/\varepsilon_{ox})+(T_{org}/\varepsilon_{org})}\right] +$$

$$2\pi\varepsilon_0R\ln\left[\frac{(T_p/\varepsilon_p)+(T_{ox}/\varepsilon_{ox})+(T_{org}/\varepsilon_{org})+(T_{H_2O}/\varepsilon_{H_2O})+(T_{gap})}{(T_p/\varepsilon_p)+(T_{ox}/\varepsilon_{ox})+(T_{org}/\varepsilon_{org})+(T_{H_2O}/\varepsilon_{H_2O})}\right]$$

where C = the capacitance determined in step (e);

ε_0 = permittivity of free space;

A = contact area of the contact means in contact with the topside of the semiconductor wafer;

R = radius of curvature of the contact means;

ln= natural log;

T_p = thickness of an oxide layer (if any) on the surface of the contact means;

ε_p = permittivity of the oxide layer;

T_{ox} = thickness of the dielectric layer;

ε_{ox} = permittivity of the dielectric layer;

T_{org} = thickness of the organic(s) (if any) overlaying the dielectric layer;

ε_{org} = permittivity of the organic(s);

T_{H_2O} = thickness of the water (if any) overlaying the dielectric layer;

ε_{H_2O} = permittivity of the water; and

T_{gap} = thickness of ~~a~~ the gap between the surface of the contact means and the topside of the semiconductor wafer adjacent where the surface of the contact means contacts the topside of the semiconductor wafer ~~supports the surface of the contact means in spaced relation to the semiconducting material~~.

13. (currently amended) A method of determining a permittivity of a dielectric layer of a semiconductor wafer comprising:

(a) determining a thickness of the dielectric layer overlaying semiconducting material of a semiconductor wafer;

(b) moving a topside of the semiconductor wafer and a spherical portion of an at least partially spherical and electrically conductive surface into contact;

(c) applying an electrical stimulus between the electrically conductive surface and the semiconducting material;

(d) determining from the applied electrical stimulus a capacitance of a capacitor comprised of the electrically conductive surface and the semiconducting material; and

(e) determining a permittivity of the dielectric layer as a function of the capacitance determined in step (d), ~~and~~ the thickness of the dielectric layer determined in step (a) and a thickness of a gap between the electrically conductive surface and the topside of the semiconductor wafer adjacent where electrically conductive the surface contacts the topside of the semiconductor wafer.

14. (original) The method of claim 13, wherein the topside of the semiconductor wafer comprises at least one of:

a surface of the dielectric layer opposite the semiconducting material; and

a surface of organic(s) and/or water overlaying the surface of the dielectric layer opposite the semiconducting material.

15. (original) The method of claim 13, further including, prior to step (b), desorbing at least one of water and organic(s) from a surface of the dielectric layer.

16. (original) The method of claim 13, wherein the electrically conductive surface is formed from a material that either does not form an oxide layer thereon or forms a conductive oxide thereon.

17. (currently amended) The method of claim 13, wherein the capacitance determined in step (d) includes a sum of:

a capacitance where the electrically conductive surface contacts the topside of the semiconductor wafer ~~supports the electrically conductive surface in spaced relation to the semiconducting material~~; and

a capacitance of ~~a~~ the gap between the electrically conductive surface and the topside of the semiconductor wafer adjacent where the electrically conductive surface contacts the topside

of the semiconductor wafer ~~supports the electrically conductive surface in spaced relation to the semiconducting material~~.

18. (currently amended) The method of claim 13, wherein the permittivity of the dielectric layer (ε_{ox})

is determined by solving the following formula for ε_{ox}:

$$C = \varepsilon_0 A[(T_p/\varepsilon_p) + (T_{ox}/\varepsilon_{ox}) + (T_{org}/\varepsilon_{org})]^{-1} + 2\pi\varepsilon_0\varepsilon_{H_2O} R \ln\left[\frac{(T_p/\varepsilon_p) + (T_{ox}/\varepsilon_{ox}) + (T_{org}/\varepsilon_{org}) + (T_{H_2O}/\varepsilon_{H_2O})}{(T_p/\varepsilon_p) + (T_{ox}/\varepsilon_{ox}) + (T_{org}/\varepsilon_{org})}\right] + 2\pi\varepsilon_0 R \ln\left[\frac{(T_p/\varepsilon_p) + (T_{ox}/\varepsilon_{ox}) + (T_{org}/\varepsilon_{org}) + (T_{H_2O}/\varepsilon_{H_2O}) + (T_{gap})}{(T_p/\varepsilon_p) + (T_{ox}/\varepsilon_{ox}) + (T_{org}/\varepsilon_{org}) + (T_{H_2O}/\varepsilon_{H_2O})}\right]$$

where C = the capacitance determined in step (e);

ε_0 = permittivity of free space;

A = contact area of the contact means in contact with the topside of the semiconductor wafer;

R = radius of curvature of the contact means;

ln = natural log;

T_p = thickness of an oxide layer (if any) on the surface of the contact means;

ε_p = permittivity of the oxide layer;

T_{ox} = thickness of the dielectric layer;

ε_{ox} = permittivity of the dielectric layer;

T_{org} = thickness of the organic(s) (if any) overlaying the dielectric layer;

ε_{org} = permittivity of the organic(s);

T_{H_2O} = thickness of the water (if any) overlaying the dielectric layer;

ε_{H_2O} = permittivity of the water; and

T_{gap} = thickness of ~~a~~ the gap between the electrically conductive surface ~~of the contact means~~ and the topside of the semiconductor wafer adjacent where the electrically conductive

surface contacts the topside of the semiconductor wafer ~~supports the surface of the contact means in spaced relation to the semiconducting material~~.